Rotational Motion of Molecules and Relaxation Time in the Isotropic Phase of Liquid Crystals

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For the purposes of studying and understanding the molecular motion of anisotropic molecules in liquids and solutions the light scattering and ultrasonically induced spectroscopy techniques are very appropriate and powerful. We carried out experiments devoted to studying temperature and frequency behavior of the ultrasonically induced birefringence in isotropic phase of nematic liquid crystal n-methoxybenzylidene-n-butylaniline (MBBA). In this sample we also investigated the temperature behavior of the depolarized Rayleigh light scattering spectra. Temperature and frequency behavior of the ultrasonically induced birefringence allow one to calculate the temperature dynamics of the relaxation time of molecular re-orientation on the base of Landau-de Gennes phenomenological treatment. Available results of the flow birefringence measurements in the isotropic phase of MBBA provide an opportunity to calculate the relaxation times, as well as to compare the results with those obtained from the ultrasonically induced birefringence measurements. From the half-width of the depolarized scattering spectra we calculated the magnitudes of the relaxation time of anisotropy fluctuations over the wide temperature range (down to the temperature of "isotropic liquid – liquid crystal" phase transition). It was shown that the ultrasonically induced birefringence may be a powerful tool to study rather slow molecular motions in the isotropic phase of liquid crystals, especially in the vicinity of transition to mesophase where the fluctuation dynamics is characterized by strong spatial correlation.